quantities in the body and possibly may play important rôles in functional capacities.

INORGANIC ELEMENTS INDISPENSABLE TO LIFE PROCESSES

L. B. Mendel [22] has characterized the inorganic elements as the "little things" in nutrition. Contrasted in a quantitative sense with proteins, fats and carbohydrates, this characterization is undoubtedly true. No doubt, since even these "little things" are indispensable in life processes, what Professor Mendel really meant to emphasize was that these "little things" must take their place along with the big things in nutrition.

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TREATMENT OF OBSTRUCTIVE JAUNDICE AND ITS COMPLICATIONS*

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PROBLEMS in the field of physiology and physiologic chemistry frequently arise during the preoperative and postoperative treatment of patients handicapped by any complicated disease. An understanding of such problems and the corrective measures necessary is often the determining factor in the patient's recovery. Without these the patient may succumb not alone as the result of the disease, but from the complications which occur during the surgical treatment. There are several striking examples of this. One is the reduction of the risk of operations on patients with exophthalmic goiter following the administration of iodin, as suggested by Plummer.[1] In the field of urology the routine preparation of all patients with obstruction from prostatic hypertrophy by the introduction of the indwelling urethral catheter permits complete drainage of the bladder. A consideration of the amount of phenolsulphonephthalein excreted at half-hour intervals and the blood urea nitrogen enables one to determine the extent of the injury to renal function and assists in making the decision as to the best time for surgical intervention. On numerous occasions, clinical investigation has revealed the value of a study of the chemical changes in the blood of patients with obstructive lesions of the stomach. The preoperative replacement in the blood stream of fluids and chlorids which have been lost to the body as the result of vomiting has greatly lowered the operative risk. In postoperative complications in the gastro-intestinal tract, Haden and Orr,[2] McVicar [3] and others have called attention to the early recognition of disturbance of motility in the gastro-intestinal tract by studies of the chemistry of the blood and using the latter as indexes of the condition of the patient, have been able to tide them over periods of toxemia resulting from gastro-intestinal stasis, by replacement of fluids and chlorids.

I wish to call attention to some problems in obstruction of the biliary tract which have arisen during the course of a seven-year clinical and experimental study, as well as in the handling of a group of sixty-seven patients with various types of obstruction of the biliary tract, on whom I have operated during the last three years. Included in the group are forty patients from whom stones have been removed from the common and hepatic bile ducts. Thirty-eight of these have had excellent results from the operation without any further evidence of biliary tract disease. Good results were obtained in the other two cases although transient jaundice or fever without pain have occurred on one or two occasions over a period of two years. Sixteen patients have been operated on for strictures of the common and hepatic bile ducts of whom fourteen are living and

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free of jaundice. Only one of the two deaths in the series occurred in the hospital subsequent to operation. The other occurred from unknown cause a year after the patient (a woman aged sixty-four) returned home. In eight patients intensely jaundiced as a result of tumors at the head of the pancreas, short circuits have been made between the distended biliary tract and the intestine or stomach for the relief of obstructive jaundice. Six of these are living, free of jaundice and of itching, and are working. Twenty-eight months have elapsed since cholecystogastrostomy was performed on one of this group.

Before the inauguration of the present-day methods of preoperative preparation of jaundiced patients, the risk of operation was abnormally increased from hemorrhage. With the development of a method of preventing postoperative bleeding by the intravenous injections of calcium chlorid as described by Bell[4] and Walters[5] in 1921 the mortality rate has been reduced to within reasonable limits; at present in the clinic it is well below 10 per cent in the group of deeply jaundiced patients. The Van den Bergh[6] method, which gives an exact measure of the amount of bile pigment in the blood stream, has assisted materially in the determination of the propitious time for operation. In general, it may be said that operations should be delayed when the bile in the blood serum is increasing. Sometimes this rule is followed with difficulty, but experience has shown that an operation at such a time is performed with great risk even though the biliary obstruction is successfully relieved. When the jaundice is decreasing, however, the patient withstands operation almost as well as though it had not existed. With the patient in good condition and the amount of bile in the blood serum decreasing, it is often advantageous to wait until the decrease reaches its lowest level before instituting surgical treatment.

STONES IN THE COMMON AND HEPATIC DUCTS

Approximately a third of the patients with stones in the common and hepatic bile ducts are not jaundiced at the time they seek treatment. The explanation for this probably lies in the resiliency of the common bile duct. Such stones can usually be recognized by palpation of the common bile duct which should be done as a routine procedure during operation as is palpation of the gall bladder. Fortunately when stones exist in the common or hepatic ducts the caliber of these ducts is considerably enlarged. The wall is usually thickened and often changed in color from the normal bluish green to nearly white. With the history of biliary colic followed by jaundice or accompanied by chills and fever, and with the finding of an enlarged common bile duct even though stones cannot be felt, it should be opened and explored with scoops. In most instances stones will be found floating in the bile in the duct. In cases of obstruction to the common and hepatic ducts due to stones, if the stones are entirely removed, convalescence is smoother than in other cases of biliary obstruction. If a stone is left in a duct, jaundice and irremediable bleeding is likely to occur, and the patient may succumb.

Bearing out the statement that this is the most successful group of cases in which to operate, is the fact that of the forty patients operated on during the last three years for the removal of stones from the common and hepatic bile ducts, thirty-eight secured excellent results. A period of more than two years has elapsed since twelve of them were operated on.

STRICTURES OF THE COMMON BILE DUCT

Successful operations with lasting good results in cases of strictures of the common bile duct are dependent on there being sufficient normal duct remaining above the stricture to permit an exact anastomosis between the duct and the duodenum. This method of direct anastomosis and the importance of establishing a mucous membrane to mucous membrane union between the stump of the duct and the duodenum was first described in 1905 by W. J. Mayo.[7] Reference will be found in the literature to the successful use of this method in numerous patients who have remained well for many years.

I recently had occasion to reëxamine a patient on whom I had made this anastomosis for a stricture of the lower third of the common bile duct more than eighteen months previously. At the time of operation, May 15, 1926, the patient was intensely jaundiced, with a serum bilirubin of 17.4 mg. for each 100 cc. of blood. A duodenal fistula developed during the first few days following operation. The accompanying toxemia was controlled by intravenous injections of physiologic sodium chlorid solution and the fistulous tract was kept dry by the suction pump. There was no further disturbance of the biliary tract.

Occasionally one finds that stricture involves the entire length of the common and hepatic ducts so that there is not a sufficient amount of duct remaining below the level of the liver to permit anastomosis with the duodenum. Such cases furnish a difficult surgical problem. Recent reports, however, of successful transplantation of external fistulous tracts into the duodenum or stomach by Lahey,[8] Masson,[9] Lilienthal,[10] St. John,[11] and Walters,[12] following the first successful case reported by Williams[13] in 1914, have served as an impetus to the use of the method when complete stricture of the extrahepatic biliary ducts exists. In general, the scheme is to establish an external biliary fistula and after it has persisted long enough to become established (usually from two to four months), the tract is coned out and transplanted into the duodenum or stomach. The ease with which such a coned-out fistulous tract can be transplanted into the duodenum is surprising.

COMPLICATIONS FOLLOWING OPERATIONS FOR STRICTURE OF THE COMMON BILE DUCT

In transplanting the remaining stump of the common bile and hepatic ducts into an opening in the duodenum the postoperative complications which are most likely to occur are duodenal fistula, accumulation of bile around the liver and subphrenic abscess. The complications occur but

rarely and only if the patient's general condition is poor and the healing capacity has been reduced as the result of prolonged biliary obstruction and jaundice.

The blood picture of clinical and experimental duodenal fistula is characterized by a drop of the chlorids of the blood, a rise in urea and in the carbon dioxid combining power of the blood, as shown clinically and experimentally by Bollman and Walters.[14] This can be adequately controlled by intravenous injections of a sufficient quantity of physiologic solution of sodium chlorid. It is advisable to keep the fistulous tract dry by some form of suction apparatus.

A few months ago, in a case in which choledochoduodenostomy had been performed for stricture of the common bile duct, all the symptoms of shock developed six hours following operation. The clinical picture in this case was characterized by a rapid rise in pulse rate, drop in blood pressure, and increase in respiratory rate. Although the operative site had been drained at the time of operation, sufficient outlet had not been provided and when the wound was opened in the patient's room, from 500 to 700 cc. of bile escaped from the space between the liver and diaphragm. Following this the pulse rate dropped from 170 to 115 within two hours. Other evidence of improvement was immediate and from then on recovery was uneventful. Experimentally, Bollman[15] and I were able to show that as a result of bile between the liver and diaphragm, the liver was depressed sufficiently to interfere with circulation to the inferior vena cava from the hepatic vein. This produced the rapid rise in pulse and respiratory rate and drop in blood pressure. When the factors causing displacement of the liver were removed immediate return to normal occurred. Thus the results in our experiments were similar to the postoperative condition in the patient mentioned.

When fever persists longer than is reasonable in cases in which operation has been performed for stricture, cholangitis or subdiaphragmatic abscess is usually the cause of the trouble. With cholangitis there is often an increase in the depth of jaundice, but in subdiaphragmatic abscess the picture is one of localized infection. In a recent case the persistence of fever over a period of two or three weeks subsequent to the healing of the wound and the complaint of pain in the region of the liver and in the right shoulder led to reopening the abdomen and the evacuation of a small abscess cavity which existed between the liver and the diaphragm and which contained from 120 to 180 cc. of inspissated pus. Drainage of the abscess and irrigation of its cavity resulted in the disappearance of fever. Normal convalescence followed.

TUMORS AT THE HEAD OF THE PANCREAS

No one is infallible in the diagnosis of causes of obstructive jaundice. Moynihan[16] put the case concisely and accurately when he said, "No matter how certain the diagnosis of malignancy may be, it is advisable to subject the patient to an exploratory operation. The chances of a life saved are so great that the risk of exploration is justified."

In 66 per cent of all persons the common bile duct passes through the substance of the pancreas before entering the duodenum. A carcinoma or inflammatory tumor in the pancreas may compress the common bile duct sufficiently to produce progressively increasing jaundice. In most of these cases the jaundice is accompanied by uncontrollable itching which is so constantly intense that the patient is glad to go to any end to be relieved. Moynihan[16] put it aptly when he said that in his opinion the incidence of suicide in such cases because of the itching is as great as the deaths from operation.

An anastomosis between the distended biliary tract, usually the gall bladder and the stomach or duodenum, produces a short circuit of bile into the intestinal tract with a relief of jaundice. If the obstruction is benign or inflammatory, permanent beneficial result is obtained; if it is due to pancreatic carcinoma, the jaundice and itching are relieved. Although he eventually succumbs to the effects of the malignancy, yet he is able to enjoy many months of comfortable existence in the interim. If a tumor is found at the head of the pancreas, the surgeon, in most instances, is unable to distinguish between an inflammatory and a malignant lesion. To remove a piece of the pancreas for microscopic diagnosis may satisfy curiosity, but it is accompanied with the danger of producing almost uncontrollable bleeding or of leakage of pancreatic secretion into the abdomen.

The beneficial results obtained from an anastomosis between the distended biliary tract and the intestine in cases of pancreatic obstruction of the common bile duct are often startling and prolonged. In a group of eight such cases six patients are living and well, free of jaundice and itching. One of them has lived more than two years since the operation. From recent examination and from information received in letters from him, his general condition is apparently satisfactory. One of the patients died on the seventh day subsequent to the operation with a clinical syndrome which was believed to be a combination of hepatic and renal insufficiency characterized by stupor and then coma, decrease in urinary output and retention of 200 mg. of urea in the blood. Necropsy did not reveal anything to explain the cause of death other than a small amount of localized peritonitis.

The anastomosis between the distended biliary tract and the intestine should be made as large as possible in order to obtain complete and immediate relief of the biliary obstruction, and so that not even temporary or incomplete obstruction is possible from edema and swelling about a small anastomosis.

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ELECTRIC SHOCK

WITH REPORT OF AN UNUSUAL CASE

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THE subject of injury produced by currents of electricity passing through the body attracts the attention of the industrial surgeon; of the medical examiners of accident insurance companies; less often that of the general practitioner; and only occasionally is a case referred to the neurologist.

The case reported at the close of this article, however, has two features of neuropsychiatric interest, and seems worthy of the somewhat detailed description given.

The literature on the subject of electric shock is scanty, and is largely to be found scattered in brief reports and small paragraphs. England has produced a much more extensive literature than the United States, including at least one standard textbook; and Dr. Willem Einthoven of the University of Leiden received one of the Nobel prizes of 1925 for his contribution to the general subject under the title, "Electricity and Nerves."

Since the subject has a threefold interest and appeal, namely—to the medical profession, to the scientific and engineering group, and to industrial concerns, the appointment of the "Commission on Electric Shock" was a logical step. This was composed of representatives of the American Medical Association, the American Institute of Electrical Engineers, and the National Electric Light Association. Nearly a year was devoted to an investigation of the subject, and a handbook and chart, with rules for the resuscitation of victims of electric shock was issued. These rules have been in large demand for distribution to workmen and for display in factories.

The government of Canada has adopted the rules officially, and has called the attention of all Canadian railways to them. Authority has been given for reprinting the same in several foreign languages.

It is estimated that these rules have been printed either in full or in abridged form about five million times. They may be obtained from the National Electric Light Association, and form a worthwhile addition to the library of any physician.

A humanitarian work of such scope, tending to prevent accidents and to save life, is deserving of more than passing mention. The valuable results to be secured through coöperation between the medical profession and enlightened business men are here well exemplified.

SUMMARY OF URQUHART'S REPORT

Some valuable experimental work done in this field by R. W. I. Urquhart has been reported in the *Journal of Industrial Hygiene*.

The summary of this article deserves to be quoted in full.

"1. The experiments herein described confirm the deductions of previous observers as to the cause of death in electric shock, namely, that it may be due to primary cardiac failure, to primary respiratory failure, or to a combination of both.

"2. In laboratory animals, when the current traverses the body from the head to a hind limb, about 45 per cent of the deaths are of purely cardiac origin. The remainder of the deaths occur because of failure of the respiratory movements.

"3. In these, as in the group in which the current is passed directly through the brain, a condition of profound paralysis or block becomes established in the respiratory, vagus, and vasomotor centers.

"4. That the block involves these centers is shown by experiments which demonstrate clearly the absence in electrocuted animals of reflex effects normally functioning through them. Since the nerve centers become insensitive to extraneous influences counterstimulation is not an aid to recovery.

"5. No definite histologic changes can be made out in the brain to account for the symptoms. The capillary hemorrhages which occur do not appear to be significant.

"6. The foregoing experiments also show defi-